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POWDER-POST DAMAGE BY LYCTUS BEETLES TO SEASONED HARDWOOD

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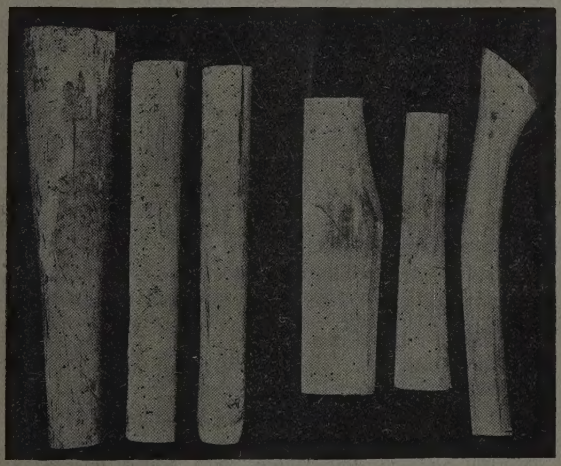

FARMERS' BULLETIN 778
UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Entomology
L. O. HOWARD, Chief

Washington, D. C. January, 1917.

POWDER-POST BEETLES often ruin stored hardwoods of the finest quality by turning them into a flourlike powder. They work in whitewood or sapwood, especially second-growth hickory, ash, and oak, which has been stored or piled in one place for two or three years or longer.

Sapwood seasoned for less than eight or ten months will not be attacked, and ***heartwood is never attacked.***

In the manufacture of hickory implement handles, when feasible substitute heartwood for sapwood. See footnote 2, page 15.

By the adoption of the following system of inspection, classification, and the proper disposal of the seasoned sapwood of hardwood stock, loss by powder-post beetles can be prevented:

Inspect material in yards and storehouses annually, preferably in November and February, and sort out and burn material showing evidence of powder post. Burn all refuse and useless sapwood material.

Classify seasoned hardwood stock into (a) hickory, ash, oak, etc.; (b) heartwood, pure sapwood, and part sapwood; and (c) according to the number of years seasoned.

Utilize or sell oldest stock first.

Inspect all new stock to prevent introduction of powder-posted material.

Use only heartwood piling sticks in lumber piles.

To prevent attack treat the more valuable material, between October and March, with boiled linseed oil. Varnish or paraffin the sapwood portions of backs and interior surfaces of cabinet work, inside finish, and furniture.

Material once attacked is usually damaged beyond repair. If the injury is not too far advanced further damage can be stopped by saturating the wood with kerosene.

While there are a number of effective chemical treatments to prevent attack, and to kill the insects in the wood, the great objection to all of them is the great and recurring expense of treating material that never would be attacked if, by the proper methods of management, the premises were kept free from the pest.

POWDER-POST DAMAGE BY LYCTUS BEETLES [1] TO SEASONED HARDWOOD.

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The sapwood of seasoned hardwood material of all kinds, both finished and unfinished, especially of hickory, ash, and oak, is often ruined by yellowish-white grubs from one-eighth to one-fifth inch in length which burrow through the solid wood in all directions and convert it into powder. These grubs are the young, or larvæ, of small, slender, somewhat flattened, reddish-brown to nearly black beetles, known as powder-post beetles. Wood that has been seasoned a year or longer is especially liable to this peculiar type of insect injury, which sometimes amounts to from 10 to 50 per cent of neglected material in storage. Powder-post damage by these beetles is widely distributed over the world and the consequent losses have been severe.

Under the general class of powder-post injury the work of insects representing several species and groups of species of beetles may be found, but by far the larger part and the most serious damage and losses are caused by different species of Lyctus.

[1] The Lyctus beetles which are responsible for the principal losses belong to four species, viz, *Lyctus linearis* Goeze, *L. planicollis* Le Conte, *L. parallelopipedus* Melsheimer, and *L. cavicollis* Le Conte. These are discussed separately on pages 12–15.

NOTE.—Systems of control which adapt certain features in business management to the habits and seasonal history of Lyctus powder-post beetles have been perfected by the Bureau of Entomology and have been adopted by many manufacturers and dealers in seasoned hardwood products, and there has been a marked decrease in powder-post losses since 1906. The object of this bulletin is to describe the methods which have been found effective in preventing these losses and to induce a more general adoption of them throughout the United States as well as to show the character and extent of the damage.

EVIDENCE OF ATTACK AND CHARACTER OF POWDER-POST INJURY.

Infested wood may be detected by the fine, flourlike powder found on or beneath piled or stored hickory, ash, oak, and other seasoned hardwood products. During the first year of infestation the powder comes from exceedingly minute holes in the wood, but after the second year the small holes from which the beetles have emerged are more or less conspicuous, and from these the powder will fall when the infested material is moved or jarred. When the wood is cut or split the interior is often found converted into a mass of closely packed powdery material which has been held together by an outer thin shell and intervening fibers of sound wood. The grubs, burrowing through the solid wood in all directions, have pulverized the wood fiber and have packed their burrows with this powdered wood. The injury by Lyctus beetles is always confined to the white wood or sapwood, although the heartwood is sometimes penetrated when the matured beetles are emerging from the wood.

CLASSES OF FOREST PRODUCTS DAMAGED.

A great variety of seasoned hardwood products is subject to powder-post damage, especially hickory, ash, and oak woodwork of farming machinery and implement handles (see illustration on title-page, and figs. 1, 2, and 3); ladder stock, as rungs, etc.; and vehicle stock, as hubs, spokes, felloes, rims, singletrees, poles and shafts. Other products affected include woodwork of electric street cars; shipbuilding lumber (fig. 4); the Army and Navy stores of handles, tent poles, wheelbarrows, oars, and many other hardwood articles; interior finish or trim and ornamental woodwork, as panels, mantels, doors, doorposts, staircases, wainscoting, flooring, etc.; construction timber, including beams, joists, roof framing, etc.; furniture, including tables, chairs, bureaus, cabinets, refrigerators (before use), filing cases (fig. 5), piano stock, bookcases, cabinetwork, etc.; inside rustic work; wood specimens and curios in museums; cooperage stock (barrel-stave bolts); shoe-last blocks; walking sticks, umbrella handles, measuring rules, and blocks to be converted into golf-stick heads; fish-net hoops; ornamental bamboo (fig. 6); Japanese fans; shuttle blocks, and "picker" sticks (for driving shuttles in looms), etc.

Hickory, ash, and oak are the kinds of wood most liable to injury, but persimmon, osage orange, black walnut, butternut, maple, elm, wild cherry, locust, poplar, sycamore, eucalyptus, sassafras, orange wood, fig, bamboo, and other woods are also attacked.

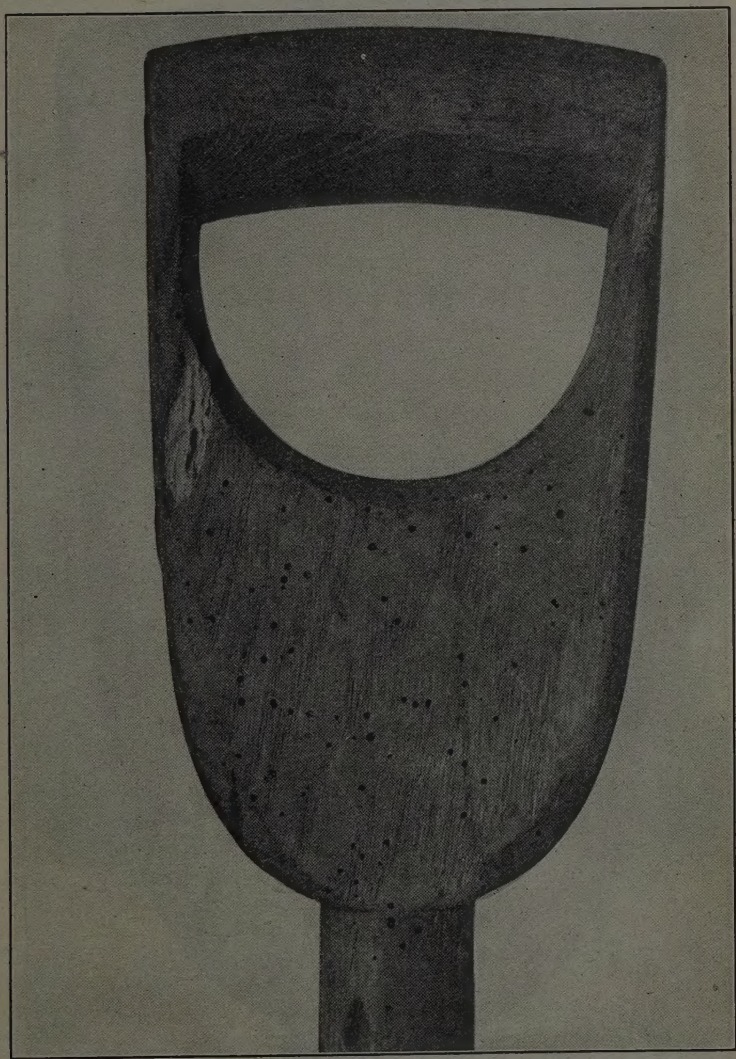

FIG. 1.—Powder-posted ash shovel handle, showing exit holes of adult beetles; the work of *Lyctus planicollis*. (Original.)

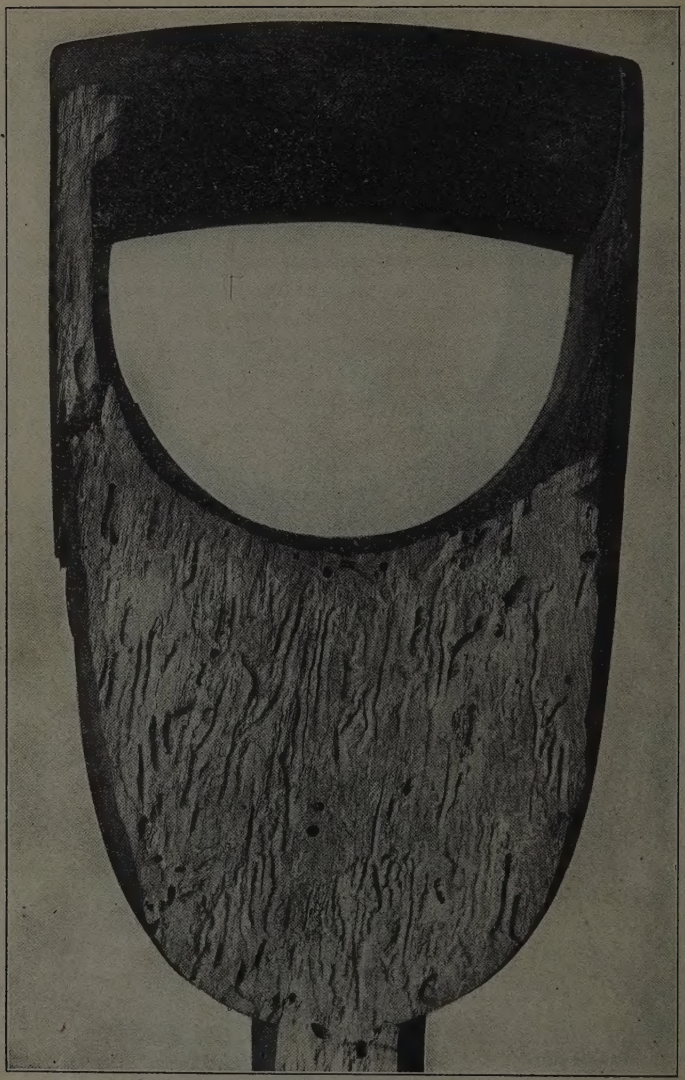

FIG. 2.—Powder-posted ash shovel handle with surface wood cut away to show burrows of larvæ within; work of *Lyctus planicollis*. (Snyder.)

EXTENT OF LOSSES AND THOSE UPON WHOM THEY FALL.

Powder-post causes a loss which falls alike on the dealer, the manufacturer or owner, and the consumer of finished products. The producer of the unseasoned or crude product is not affected, because it is only after the wood is seasoned a year or more that it is attacked and damaged by these insects. Second-growth sapwood of the best

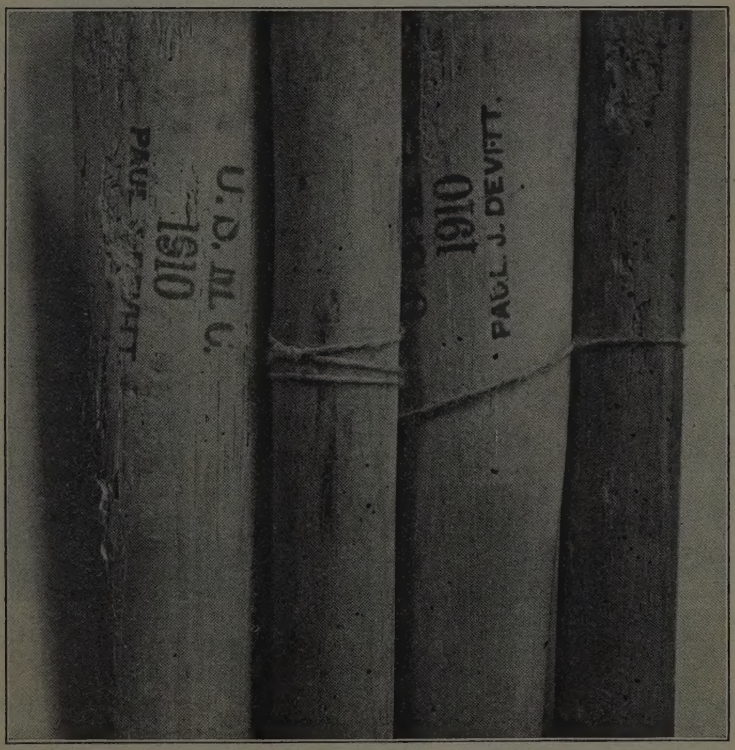

FIG. 3.—Powder-posted hickory pickax handles, showing exit holes of adult beetles; work of *Lyctus linearis*. (Original.)

quality is particularly liable to attack and serious injury, especially when it has been stored or piled in one place for two or three years or more.

The loss to seasoned hardwood products ranges from 1 to 50 per cent, sometimes representing thousands of dollars to a single manufacturer or dealer who neglects to adopt the proper preventive measures. The affected articles are not only reduced in value, but frequently are rendered worthless for the purposes for which they are intended. In the aggregate the direct financial loss that has been

caused by these beetles in this country has amounted to hundreds of thousands of dollars annually. The loss increases with the length of time the infested stock is held in storage. In certain cases powder-post injury may be a menace to human life as in the weakened wood material of vehicles, ladders, etc.

CHARACTER OF THE INSECTS WHICH CAUSE THE DAMAGE.

The Lyctus beetles are small, slender, somewhat flattened, brownish to nearly black beetles, which, upon emerging from the wood where

FIG. 4.—Powder-posted white ash shipbuilding lumber, showing burrows of larvæ and exit holes of adult beetles; board from closely piled stack of lumber throughout which larvæ had burrowed; work of *Lyctus planicollis*. (Original.)

they breed and pass the winter as larvæ, fly or crawl about in search of suitable wood material in which to deposit their eggs.

HABITS AND SEASONAL HISTORY OF LYCTUS BEETLES.

There are four stages in the life history of these insects—namely, the egg, the larva or grub, the pupa or resting stage, and finally the adult or beetle.

The egg (fig. 7) is deposited in the pores of the wood by the female beetle soon after it emerges from the wood. The minute larva which hatches from the egg proceeds to burrow in and through the wood in all directions, feeding and growing as it proceeds, until it has attained its full size. The full-grown larva (fig. 8) is a yellowish-white grub ranging in length from one-eighth to one-fifth of an inch,

with three pairs of legs, and with the tip of the body curved under toward the head. Upon reaching maturity as a larva it excavates a cell at the end of its burrow (fig. 9), and in this transforms to the pupa (fig. 10). Later the pupa changes to the adult beetle (fig. 11), which can fly in search of suitable places to lay its eggs.

FIG. 5.—Powder-posted oak file case, showing exit holes of adult beetles; work of *Lyctus planicollis*. (Original.)

Seasoned wood is attacked by these beetles because the chemical changes which take place in the process of seasoning render the nutritive substances in the wood, such as sugar and starch, especially suitable as food for the development of the young or larval stage.

Each female beetle deposits many eggs,[1] and many females oviposit in a single piece of wood, so that the combined work of their nu-

[1] A large female of *Lyctus planicollis* Lec., about one-fourth inch in length, that was dissected contained ovaries as two separate, elongate ovate clusters one-tenth inch in length, one of which was about one-third the size of the other. These ovaries took up most of the space of the abdomen. The eggs were arranged in rows so as to have the appearance of being braided. The mature ovules, or fully formed eggs, are pointed at one end and rounded at the other, with the rudimentary strand present at the rounded end. The egg surface is apparently granular. At least 40 eggs were in the larger mass.

merous progeny, burrowing through the wood in quest of food for their development, results in the complete destruction of the interior wood fiber and its conversion into a mass of fine powder. If the first attack and the first generation do not accomplish this destruction, subsequent generations will follow in the same wood until nothing of the solid fiber is left but a thin outer shell.

FIG. 6.—Powder-posted ornamental section of bamboo, showing exterior and interior of split bamboo; work of *Lyctus parallelopipedus*. (Original.)

The different kinds of Lyctus beetles vary somewhat in their habits and seasonal history, but there is a general similarity. They pass the winter as larvæ in the wood, change to pupæ in the early spring, and during late spring and early summer the adult beetles emerge from the wood and fly about. Under natural out-of-door conditions the eggs are laid in the pores of the wood soon after activity commences in the spring, but in storehouses, sheds, or buildings kept warm and dry, the development may take place and the eggs may be deposited much earlier.

The larvæ remain dormant or active in the wood, according to the temperature of the place where stored, and in consequence infestation in wood stored in cold places may pass unnoticed. If the wood is re-

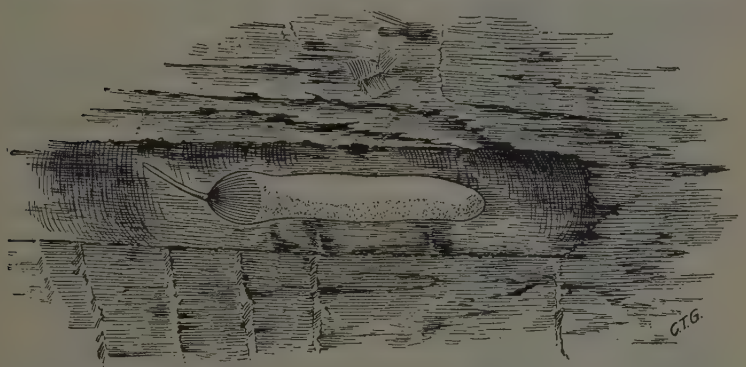

FIG. 7.—Egg of a powder-post beetle, *Lyctus planicollis*, in pore of wood on radial section of ash ladder-rung stock; pore opened to show egg. Highly magnified. (Snyder.)

moved from outdoors, open storage sheds, or other places which are cold in winter, to the dry kiln, the dormant larvæ start to work in the wood, as shown by the ejection of boring dust or powder. Handling or jarring infested wood appears temporarily to stop the activity of larvæ contained in it.

FIG. 8.—Larva of a powder-post beetle, *Lyctus planicollis*. Enlarged. (Chittenden.)

In general, the adults or beetles are active between the first of March and the last of July at Washington, D. C. (about latitude 39° and longitude 77°, and practically at sea level), but the period varies according to the species, the temperature of the storerooms, and the geographical location. According to the senior author, the variation due to latitude, longitude, and altitude from a date at Washington, D. C., will be approximately four days for each degree of latitude, 5° of longitude, and 400 feet of altitude, being earlier in the season southward, westward, and descending. The number of adult beetles that might be active and deposit eggs after the last of July at Washington, D. C., is so insignificant that practically no damage is done by them. Therefore the danger of attack would be over relatively earlier at parts south of Washington and westward, and later northward. The approximate dates of flying and

egg laying by each species under outdoor conditions at Washington, D. C., are given on pages 13, 14, and 15.

So far as known there is only one generation annually.

FIG. 9.—Pupal cells of *Lyctus planicollis* in powder-posted white-ash shovel handle. (Snyder.)

THE FOUR SPECIES RESPONSIBLE FOR MOST OF THE LOSSES.

While, as previously stated, there are many species of Lyctus beetles in the United States, the European Lyctus, the southern Lyctus, the velvety Lyctus, and the western Lyctus are the four species responsible for practically all the losses.

THE EUROPEAN LYCTUS.[1]

The European Lyctus beetle is rusty red-brown, slender, somewhat flattened, elongate, and from one-tenth to one-fifth inch in length. The wing covers have single rows of large, rounded, very shallow punctures.

This species is commonly met with in northern Europe under natural conditions as well as in commercial products, especially in England, France, and Germany. Therefore it is evident that it was introduced into this country from Europe. In addition to the wide distribution of this species in the temperate zones of the world, it is especially common and destructive in the States north of North Carolina, Tennessee, and Arkansas. There are a great many records of damage to seasoned hardwood products by this beetle from this area, including Maine, Massachusetts, New York, Pennsylvania, Virginia,

FIG. 10.—Pupa of a powder-post beetle, *Lyctus planicollis*. (Chittenden.)

[1] *Lyctus linearis* Goeze.

West Virginia, Ohio, Indiana, Illinois, Missouri, Iowa, Michigan, and Minnesota. The great number of specimens in the collection of the United States National Museum show but a single record from the South Atlantic and Gulf States, and this is evidently a temporary introduction. Undoubtedly the species is frequently carried into the southern region, but evidently it does not survive there. This beetle is common in commercial products of seasoned hickory, oak, walnut, and ash, and occasionally in poplar, wild cherry, and locust. It is not recorded from natural growth in the open in this country, but is said to infest such growth, as well as commercial products, in Europe.

Adults of the European species, which has been shown to have a relatively northern distribution in the United States, begin activity as early as the first part of March in its southern distribution and are still active during the first part of August in its northern distribution, general emergence of the adult beetles from infested wood occurring at Washington, D. C., from April until June. The eggs are deposited soon after the adult beetles emerge and are inserted into the pores of the wood by means of a long, slender, flexible ovipositor. The winter is passed in the larval stage in the wood. General pupation occurs from about the middle of April to the first of May in the District of Columbia.

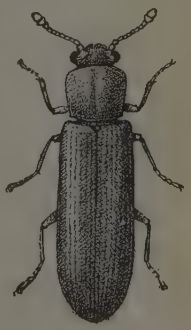

FIG. 11.—Adult powder-post beetle, *Lyctus planicollis*. (Chittenden.)

THE SOUTHERN LYCTUS.[1]

The southern Lyctus beetle is pitchy black, slender, somewhat flattened, elongate, and from one-tenth to one-fifth inch in length. The wing covers have smaller, finer, and deeper punctures in more or less distinct double rows. Individuals of this species vary extremely in size, and there is marked difference in size between the sexes, the males often being much smaller than the females. As the result of continued breeding in the same wood for several generations, in confinement the beetles were found to decrease in size.

This species is injurious to hardwood products in and from the South Atlantic and Gulf States to California, Arizona, and Nevada. This range probably represents the natural distribution of this southern species. It is frequently introduced into the Northern, Central, and Western States and transported to other countries, but this apparently never results in its permanent establishment except in warm storehouses. There are definite records of its occurrence at Cape

[1] *Lyctus planicollis* Lec.

Town, South Africa, in lumber received from the southern United States, and at Buenos Aires, Argentina, in the ash wood in refrigerators and shovel handles from the United States.

The southern Lyctus has been recorded as breeding under natural conditions in this country and is common in the Southern States in commercial products, such as seasoned ash, oak, hickory, persimmon, and sycamore. Rearing records show that it may breed continuously in the same wood during a period of at least six years, or until all the wood tissue has been converted into powder. The beetles emerge from infested wood of commercial products in heated buildings much earlier than where exposed to outdoor conditions. Owing to the character of the class of commercial products infested by Lyctus beetles, which are often stored indoors, there apparently are no great differences in the periods of activity of adults of species of northern and southern distribution.

Adults of this southern species are active from the middle of February till the last of September in the South Atlantic and Gulf States. General emergence of the adult beetles and mating occur from the middle of April to June, and very few beetles emerge at Washington, D. C., after the first part of July. Egg laying occurs a few days after emergence, and the eggs hatch after a period of not longer than 10 days. The winter is passed as larvæ in the wood, and full-grown larvæ are in the pupal cells at Washington by the first part of February. General pupation of the larvæ in the infested wood in rearing experiments at Falls Church, Va., occurred from about the middle of March to the first part of April.

THE VELVETY LYCTUS.[1]

The velvety Lyctus is rusty red-brown to black, slender, flattened, and elongate, and from one-twelfth to one-sixth inch in length. The punctures on the wing covers are very fine and obscure and not placed in rows; the fine, dense, yellowish hairs on the wing covers are prominent, which gives the beetle a velvety appearance.

Extensive observations have been made on the habits of this species, which has been recorded as injurious in Texas, Louisiana, Florida, Georgia, South Carolina, Virginia, West Virginia, District of Columbia, Long Island, New York, Ohio, and Missouri.

The natural distribution of the species is evidently in the South Atlantic and Gulf States and in part of the Mississippi and Ohio River Valleys, from which it has been temporarily introduced into other States.

This beetle infests the seasoned sapwood of commercial products made from persimmon, hickory, ash, oak, and bamboo; it also lives

[1] *Lyctus parallelopipedus* Melsh.

in the dead wood of natural growth of osage orange, sassafras, and fig.

Adults of the velvety Lyctus are active from the middle of March till the last of August at Washington, D. C. General emergence occurs from June to the last of July.

THE WESTERN LYCTUS.[1]

The western Lyctus is a rusty red-brown, slender beetle, somewhat flattened and elongate, and from about one-seventh to about one-fifth inch in length; the punctures on the wing covers are very fine and placed in more or less distinct double rows.

This species is recorded from California in commercial products, seasoned orange wood and hickory, tanbark oak, and cordwood of live oak.

Adults of this species are active from April till the middle of September.

CONDITIONS FAVORABLE FOR ATTACK.

Second-growth white wood or sapwood of the finest quality of hardwoods, especially hickory, ash, and oak, which has been stored or piled in one place for two or three years or longer is especially liable to damage by Lyctus beetles. This is particularly the case if the material has not been handled or moved and if the old stock is allowed to accumulate. Refuse and useless sapwood material and infested stock piled about the sheds or yards, sapwood piling sticks, etc., are sources of infestation. If the different species of hardwoods are not placed in separate piles, the species of woods not so liable to attack often become infested.

CONDITIONS UNFAVORABLE FOR ATTACK.

Material of species other than hickory, ash, and oak is less liable to attack. Sapwood seasoned for less than 8 to 10 months will not be attacked, and *heartwood is never attacked*[2] (fig. 12).

The conditions will be rendered very unfavorable for attack by powder-post beetles wherever hardwood stock in yards and storehouses is handled as follows: Material inspected and rehandled annually, preferably in November and February, and that showing evidence of powder-post attack sorted out and burned; all refuse and useless sapwood material burned; as far as practicable, all dry or seasoned hardwood stock separated into heartwood, pure sapwood, and part sapwood, and into hickory, ash, oak, etc., and classified according to the number of years it has been seasoned, *and the oldest*

[1] *Lyctus cavicollis* Lec.

[2] Exhaustive strength tests conducted by the Forest Service show that the heaviest, and consequently the strongest, hickory averages below 10 rings per inch in rate of growth, and that, weight for weight, red hickory (heartwood) is as strong as white hickory (sapwood).

stock utilized and sold first; accumulations of refuse material in which the insects could breed prevented; the introduction into lum-

FIG. 12.—Powder-posted sapwood oak veneer laid on a core of chestnut (door stock); work of *Lyctus planicollis*. Note that the heartwood oak and the chestnut have not been attacked. (Original.)

ber yards and storehouses of material infested with powder post prevented; and, finally, heartwood instead of sapwood piling sticks used in the piles.

INSECT ENEMIES OF LYCTUS BEETLES.

There are many insect enemies of powder-post beetles. Among the beetles, species of the family Cleridae are often beneficial in checking the multiplication of Lyctus beetles, the larvæ preying on the Lyctus larvæ and the adults preying on the Lyctus adults. Other beetles which commonly prey upon the powder-post beetles belong to two other families.[1]

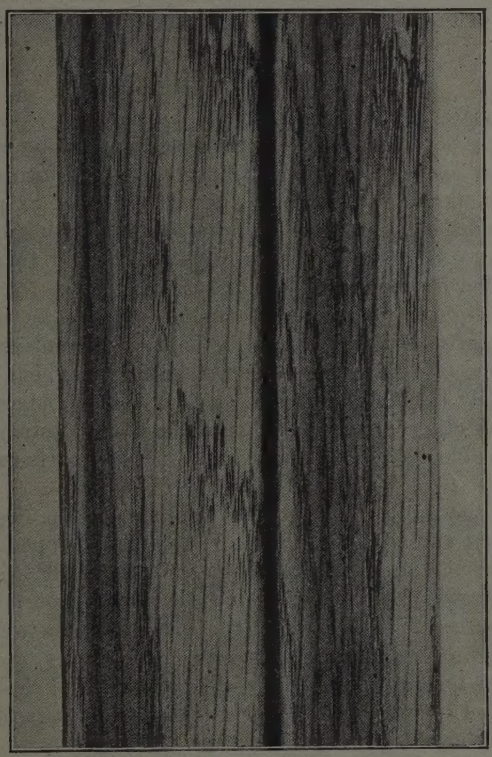

FIG. 13.—Exit holes of small, four-winged, wasplike parasites of Lyctus in powder-posted red oak interior finish. (Original.)

Many species of small, four-winged, wasplike parasites have the Lyctus beetles as their hosts. The emergence or exit holes of the adult parasites (fig. 13) are much smaller than those made by the beetles, but are often mistaken for those made by young Lyctus larvæ.

[1] Histeridae and Cucujidae.

In general, these insect enemies, although beneficial, can not be depended upon to keep the destructive beetles under control, and therefore usually can be disregarded when practical control measures are being instituted.

METHODS OF CONTROL.

The methods of combating this class of insects and of preventing losses from their ravages come under two primary heads: (1) The destruction of the insects, or remedies, and (2) prevention of attack.

REMEDIES.

Infested material, including infested sap edges of lumber, etc., and all refuse sapwood in which the insects might breed should be eliminated by sorting it out and disposing of it by burning or otherwise. All material showing the slightest evidence of powder-post damage should be discarded and destroyed, except possibly such articles as may be tested for required strength and found to be of sufficient value for retention after treatment.

Material slightly infested and damaged should be treated with kerosene oil, after which it should be kept in quarantine a sufficient length of time to determine whether a second treatment is required.

All partially damaged material, such as the sap edges of lumber and parts of other material too valuable to be destroyed, should, when practicable, have the damaged and infested parts cut away and burned.

The work should be done between October and the first of March in storehouses, and before the first of April in the open. If this is thoroughly done and, by annual inspection thereafter, infested material is disposed of as soon as found, there will soon be no trouble from this source, unless there is a continued introduction in lumber and material received from other yards and localities where methods of control are neglected. To avoid this, all material should be carefully inspected before shipment, or at least before it is placed in the yards or storehouses.

Where it is not practicable to remove the infested parts, or in case of the more valuable stock, the wood should be subjected to methods of treatment for the destruction of the insects between October and the first of March. Of the following remedies, that most suitable in each case should be selected, remembering that the treatment must not be detrimental to the wood for subsequent uses.

(1) Liberal applications of pure kerosene oil with a brush, or immersion of infested wood in vats of kerosene. The only objection to kerosene is the fire risk. However, kerosene soon evaporates, so that the treated material is not long near the danger point. Kero-

sene oil does not affect the application of shellac or varnish; the only effect on finishing is to make it more difficult to stain kerosene-treated sapwood to match the rest.

(2) Mixtures of 3 parts creosote and 1 part kerosene oil; 3 parts kerosene oil and 1 part creosote (to obtain a deeper penetration); and 1 part creosote and 3 parts naphtha have been used successfully. The wood should be dipped in vats of preservative, preferably heated by coils of steam pipe, or the preservative may be applied hot with a brush. *Of course, mixtures containing kerosene oil should not be heated over a direct fire.*

(3) Thorough steaming of the infested wood in a tight room or under pressure. Steaming under pressure weakens and discolors the wood and should not be applied to wood to be used for fine finish or where strength is essential.

(4) Subjecting seasoned wood to temperatures over 200° F. in dry kilns.

(5) Fumigation of infested wood in tightly closed drying rooms with the fumes of sulphur at the time of the emergence of the adult beetles. This has been recommended for killing the beetles and preventing egg laying.

The objection to treating infested material lies in the fact that if it is once infested it may be damaged beyond repair and not safe for future use. A break might result in a serious accident and reflect on the reputation of the manufacturer or distributor.

PREVENTION OF DAMAGE.

By the adoption of the following system of inspection, classification, and the proper disposal of the seasoned sapwood of hardwood stock, loss by powder-post beetles can be prevented:

(1) Inspect material in yards and storehouses annually, especially stock two or more years old, preferably in November and February. Then (a) sort out and burn material showing evidence of powder-post attack and (b) burn all useless sapwood material.

(2) Classify all dry or seasoned hardwood stock as (a) hickory, ash, oak, etc.; (b) heartwood, pure sapwood, and part sapwood; and (c) according to age, that is, the number of years it has been seasoned.

(3) *Utilize or sell oldest stock on hand first. Prevent the accumulation of old stock; in other words, keep the stock moving.*

(4) Prevent the accumulation of refuse material in which the insects can breed.

(5) Use only heartwood piling sticks in lumber piles.

(6) Inspect all new stock to prevent the introduction into lumber yards and storehouses of powder-posted material.

(7) If the beetles have not been eliminated from the yards and storehouses, stock that has been seasoned longer than eight months,

and which is to be held in storage, may be rendered immune by treating it with two coats of boiled linseed oil applied hot, or it may be immersed in vats of hot oil. The boiled oil will dry more rapidly than the raw linseed oil, especially if kerosene is added to the hot oil. The wood should be treated between October and the 1st of March.

Linseed oil has an advantage over other substances in that it can also be profitably applied to unseasoned timber, since it will prevent checking in seasoning. This oil stains the wood slightly yellow. In case of wagon stock, however, it can be used without prejudice to the trade and is an effective preventive.

Creosotes can be effectively used in case of stock to which the brown stain will not be detrimental. The wood should be dipped in vats of hot creosote, or the preservative should be applied hot with a brush.

In case of finished products or more valuable material, any substance which closes the pores of the wood may be effectively applied. For example, paraffin wax, varnish, etc., effectively close the pores of the wood and prevent the beetles from depositing the eggs, which are laid in these pores. Thus the sapwood portions of backs and interior surfaces of cabinet work, inside finish, and furniture, etc., should also be treated to prevent attack.

In conclusion it may be stated that while there are a number of effective chemical treatments to prevent attack, and to kill the insects after they get into the wood, the great objection to all of them is the great and recurring expense of treating material that never would be attacked if, by the proper methods of management, the premises were kept free from the pest.

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